

**Wisconsin Highway Research Program  
Request for Proposal for**

**Comparison of Fresh Concrete Air Content Test Methods & Analysis of Hardened Air  
Content in Wisconsin Pavements**  
(Revised and reissued January 9, 2013)

**Questions regarding the content of this RFP are due no later than  
4:30 PM (CST), Wednesday, January 23, 2013**

**Responses to questions will be posted to the WisDOT Research and Library website  
(<http://wisdotresearch.wi.gov/rfps-and-proposals>) by  
4:30 PM (CST), Tuesday, January 29, 2013**

**Proposers must submit an electronic version of a proposal (Adobe PDF required) by  
4:30 PM (CST), Friday, February 15, 2013  
to [apakes@sustainability.wisc.edu](mailto:apakes@sustainability.wisc.edu)**

**For further information regarding this RFP contact:  
Angela Pakes Ahlman  
email: [apakes@sustainability.wisc.edu](mailto:apakes@sustainability.wisc.edu)**

**Researcher Questions on RFP**

Please refer all questions on this RFP to the WHRP Technical Director, Angela Pakes Ahlman by the aforementioned due date. Questions must be in writing. No response will be provided to questions received after the due date.

**Researcher Proposal Preparation Guidelines**

WHRP Proposal Guidelines are available on the WisDOT Research and Library website (<http://wisdotresearch.wi.gov/wp-content/uploads/WHRP-RFP-Guidelines-11-26-12.pdf>). Please refer to these instructions in preparation of your response.



**Wisconsin Highway Research Program  
Request for Proposals  
Rigid Pavement Technical Oversight Committee**

**Title**

**Comparison of Fresh Concrete Air Content Test Methods & Analysis of Hardened Air Content in Wisconsin Pavements**

**I. Background and Problem Statement**

The recent study funded by Wisconsin Department of Transportation (WisDOT), entitled “Field Study of Air Content Stability in the Slipform Paving Process”, has revealed as much as 5% lower fresh air content in the field by the pressure meter method (ASTM C 231) when compared to hardened air content in cores from the same pavements determined by the ASTM C 457 method. The study found that differences were most profound when using synthetic air-entraining admixtures (AEA) that are taking the place of vinsol resin AEA in the marketplace. Data from the referenced study suggests these newer AEAs may have greater surface tension than can be accurately measured by the current pressure meter method. The problem to be addressed is whether the pressure meter can: (1) accurately measure fresh air content when these newer AEAs are used in slipform paving mixes or (2) are there more accurate field methods that can be employed to measure fresh air content. Determining accurate air contents on fresh concrete in the field will allow the Department and the paving industry to optimize properties of the concrete mix in regards to strength, durability and economy.

In addition to the question raised about measuring air in fresh concrete, the air entrainment visible in the hardened concrete in the above mentioned study demonstrated clustering around aggregate particles. This could result in concretes with more air than desired, and interconnected and irregular void patterns. These differences in air void structure can lead to a decrease in durability, and therefore, the pavement life. The Department would like to know if this is a common occurrence, and get a better idea of the true air void structure in concrete pavements.

**II. Objectives**

The first objective of this study is to evaluate fresh air content test methods to determine accuracy of the methods in comparison to the hardened air content of the same concrete pavement.

The second objective of this study is to determine the hardened air content and air void dispersion in Wisconsin’s concrete pavements. In this part of the study, cores taken by WisDOT from concrete pavements placed in 2013 and 2014 will be compared to test records from those projects. The objective of this comparison is to determine how much of a difference there is between the hardened concrete cores and the measured air from the fresh concrete testing done as part of the project. This will help us determine if changes to WisDOT specifications are necessary. It is also hoped that these cores can document the frequency of air void clustering

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around aggregates, potential segregation of air in the mix, and also if air void density changes within the concrete. The Department would like to know if there are any trends in air void structure that may be attributed to aggregate type (limestone or gravel), mix type, and air entrainment admixture.

### **III. Scope of Work**

Proposal: In the initial project proposal, the research team will be expected to define the scope for a complete literature search of the topic, define a detailed sampling plan utilizing project mandated testing methods for air content to obtain a representative and meaningful data set, and define an easily understandable approach to analyzing and presenting data and findings to a broad audience of end users. The research team should also state the total number of different field PCC mixtures that will be tested within the defined budget for this study and the proposed coordination with the contracting industry for collection of data. The research team should also state the number of cores that will be tested as part of the research plan. Please specify how many cores will be taken from the projects where the researcher provided fresh concrete testing as part of this project, and how many cores will be obtained by the department for the researcher as part of their annual coring.

Task 1: Researcher will conduct a comprehensive literature search on the topic and make final recommendations for testing air in the field, reporting the results back to the Rigid Pavement Technical Oversight Committee.

Task 2: Based upon the literature search and the meeting with the TOC, the Researcher shall develop a detailed final testing matrix for measurement of air contents on paving projects. TOC has mandated fresh air content will be performed using the following methods for each paving project: (1) Gravimetric Method including unit weight, (2) Pressure Method (using Meter Type B) and (3) Volumetric Method.

Hardened air contents will be performed on 6" by 12" test cylinders (taken during fresh air content testing) utilizing Linear Traverse Method A of ASTM C 457. Hardened air content will also be done on cores from select paving projects from the 2013 and 2014 paving season (obtained by the department during random pavement coring throughout the 2 construction seasons). Factors to be considered as part of the hardened concrete testing matrix will include the number of cores to be tested, variables considered in the study, air void clustering, and any other factor that may impact the air void structure and quantity in the cores. Experimental hardened air content devices and methods will not be considered for this study. Final selection of projects in which testing will be performed will be in consultation with WisDOT staff.

Task 3: will include the field work and all testing required for the project and measurement and documentation of concrete properties in the required testing matrix. The research team will be responsible for all aspects of materials, equipment and transportation to and from the construction projects selected. All project personnel on the construction projects will have HTCP PCC Level I and ACI Field Technician Grade I certification. All specimens for fresh and

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hardened air content will be rodded and not internally vibrated. For the purposes of this study, it is permissible to use the pressure meter bowl to perform the gravimetric test prior to running the pressure method.

Task 4: will include analysis and summary of all test data, preparation of final report and formal presentation of the project to the Rigid Pavement Technical Oversight Committee.

Required Concrete Properties to be Included in Test Matrix:

The following fresh concrete properties shall be measured per the cited specification procedures:

- Air Content – Pressure Method (AASHTO T152)
- Air Content – Gravimetric Method (AASHTO T121)
- Unit Weight (AASHTO T121)
- Air Content - Volumetric Method (AASHTO T196)

The following hardened concrete properties shall be determined per the cited specification procedures:

- Determination of Air-Void Content and Parameters of Air-Void System in Hardened Concrete (ASTM C457), Method A Linear Traverse
- Fresh air content (AASHTO T152) *from project records for department provided cores*
- Compressive Strength of Concrete (AASHTO T22) *from project records for department provided cores*

**Requirements for Test Matrix**

Mix Variables

The projects selected for fresh air field measurement must include similar mix types in the test matrix of the following representation:

- Northern WI aggregate mix
- Southern WI aggregate mix

Northern coarse aggregate type shall be a typical northern WI glacial gravel. Southern coarse aggregate shall be a crushed limestone.

It is anticipated there will be significant coordination required with the Wisconsin Concrete Pavement Association and its members in order to find projects having a similar paving mix and aggregate types mentioned above.

WisDOT/TOC Contribution: TOC contact will consult with research team in final selection of projects. It is expected that WisDOT will make available all cores taken from concrete paving projects during the 2013 and 2014 paving seasons. They will be held for the researcher at the Truax Materials Lab, 3502 Kinsman Blvd, Madison, WI 53704. The department will provide requested testing records from the cored pavements to the researcher via the Materials Tracking System (MTS).

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Requirements for Laboratory/Technician Certifications: HTCP PCC Tech I and ACI Field Technician - Grade 1 certifications required.

Required for Travel to Fulfill TOC Obligations: The researcher will need to pick up the cores from WisDOT, or make arrangements to have them shipped to their researcher's facility. Travel to Madison to report the results of the study to the Rigid Pavement TOC in Task 4 is required.

**IV. Specific Results, Findings, Tools, etc. (Deliverables)**

- a) Reporting Requirements. 8 Hard Copies Delivered to WHRP by the contract end date.
- b) Presentation Requirements. All projects require the PI to give a closeout presentation after submittal of the draft final report.

**V. Budget and Time Frame**

- a) Proposed Project Duration is 24 months. (starting October 1, 2013 and ending September 30, 2015)
  - Deadline for submittal of draft final report is June 30, 2015.
  - Deadline for submittal of Final Report is September 30, 2015.
- b) Project Budget shall not exceed \$100,000

**VI. Implementation**

- a) This study will develop recommended values for concrete properties to be used by the Department in the Standard Specifications for Highway and Structure Construction and the applicable Standard Special Provisions, QMP for Concrete Pavements and QMP for Ancillary Concrete.
- b) Recommendation on the proper method and procedure to determine fresh air in concrete on WisDOT projects.
- c) Researcher is expected to communicate the following:
  - i) Recommended potential changes in practice.
  - ii) Benefits in terms of performance and cost savings.